



Orthodontic treatment of anterior open bite

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Abstract— It is increasingly common for orthodontists to perform compensatory treatments for the correction of malocclusions presented by their patients, through a mechanism that is efficient and enables good results and long-term stability. An open vertical bite is defined as an open bite between the upper and lower incisal borders. It is one of the malocclusions of greater functional aesthetic impairment, with several etiological factors involved. It is emphasized that it is a discrepancy in the vertical direction, making it more difficult to correct and with less stability in its final results. Given the above, the objective of this article is to review the literature on orthodontic treatment in anterior open bite. The methodology used was an integrative literature review. In the first stage of the study, 227 articles were found, which referred to the orthodontic treatment of the anterior open bite (MAA). After reading the titles of the selected articles, 112 articles were selected. After reading the abstracts, only 55 studies were selected to be included in the critical and integral reading. Finally, 13 studies met the inclusion criteria. In clinical situations where a diagnosis is anterior open bite, during the mixed dentition period, the treatment option is the indication of the removable acrylic with Hawley's arch, the expander screw and palatal grid. However, it is important to note that success treatment in this case is also due to the cooperation of the patient.

I. INTRODUCTION

The term “open bite” was used by first time by Caravelli, in 1842, as a distinct classification of malocclusion, which can be defined in different ways. Some authors consider open bite, or tendency to open bite, when overbite is less than than the one considered normal. Others consider open incisal relationships to be an open bite. Still others specify that there is a need to lack of incisal contact to diagnose a open bite (ANTOUN et al., 2018).

The anterior open bite (MAA) is defined as absence of positive vertical overlap between teeth upper and lower anterior. It is a great challenge for professionals, to carry

out the treatment of this malocclusion in adult patients, because in addition to the functional correction, it is necessary to obtain a satisfactory facial aesthetics and stability of the results . The anterior open bite can be classified into skeletal or dental (BONA et al., 2016).

The treatment of skeletal open bite, carried out in adulthood, presents great difficulty, since that its correction, in most cases, is associated surgical therapy. However, many patients and their families they are reluctant to accept surgical treatment, whether for financial reasons or for fear of the risk inherent in the surgical procedure. Therefore, and considering the need for treatment of these patients, orthodontics compensatory

action, has stood out as an alternative viable treatment. The anterior open bite (MAA) should be considered a complex and multifactorial malocclusion, being thus, numerous factors contribute to its occurrence and severity. It is worth noting that this bad occlusion can be associated with any facial pattern, however, vertical, long-faced patients have worse prognosis (FONSECA et al., 2019).

Jaw surgery should be rated higher in cost and risk than elastics for lengthen the incisors or occlusal reduction of the posterior teeth. On the other hand, if the less difficult procedures would provide little real benefit to the patient, while the jaw surgery would promote considerable benefit, cost-risk / benefit analysis it can also favor the most difficult procedure (ANTOUN et al., 2018).

We recognize that due to the advances achieved in recent years by orthognathic surgery, this therapy has greater predictability regarding the correction of malocclusion. The treatment occurs through counterclockwise rotation of the mandible which has the consequence of decrease in lower anterior facial height. However, some patients reject it as a way of treatment for socioeconomic issues and or even for the phobia of surgery.

In these patients, orthodontists are left with the application of orthodontic mechanics as a therapeutic procedure in order to improve these patients functionally and aesthetically.

There are few published studies on the orthodontic treatment of open bite in adult patients. When referring to this theme, several authors approach it, but referring to growing patients. This can be explained by the fact that, in adult patients, a malocclusion characterized by an open bite can be one of the most difficult problems to correct itself through orthodontic treatment. Thus, the patient adult would be left with surgical correction or orthodontic compensation.

Given the above, the objective of this article is to review the literature on orthodontic treatment in anterior open bite.

II. HELITERATURE REVIEW

The basic etiological factors of anterior open bite are related to heredity and to environmental factors. In the phases of deciduous and mixed dentition, the factors most common etiological factors are environmental: tonsil hypertrophy, mouth breathing and especially deleterious mouth habits. The skeletal impairment is small in these cases. For that reason it is very important that environmental aetiological factors are stopped early, because in the permanent dentition phase, the involvement

skeletal-alveolar becomes larger, mainly if aggravated by a associated vertical growth pattern. Therefore, treatment in late stages is much more complex and unstable, involving, in some cases, cases, orthognathic surgery (JANSON; VALARELLI, 2015).

In the normal development of denture, a vector set of forces of the same intensity are directed at the teeth and their alveolar components in two directions: from lingual to vestibular and vice versa. The language consists of a powerful set of muscles that exerts very intense force on the teeth. Opposed to it, there is the action of a "muscular belt", which involves the dental arches externally and that was named by BRODIE as "Buccinator mechanism". In a normal situation, these forces are neutralize, so that the teeth and adjacent structures remain in balance (ALMEIDA, 2013).

However, any factor that interferes with this homeostasis in the growth and development of facial structures, can alter the morphology and function of the stomatognathic system. As triggering factors are deleterious oral habits, hypertrophic tonsils and mouth breathing. Furthermore, the development and intensity of open bite are related to facial growth pattern (BOB et al., 2014).

Alveolar teeth and bones are exposed to antagonistic forces and pressures arising mainly from muscle function, which in part can determine dental position. On the other hand, the forces of the lips and tongue at rest generate the condition of balance for the position of the teeth. By definition, balance exists when a resting body is subjected to forces in several directions but does not accelerate; or, in the case of teeth, it does not undergo displacement (FABRE et al., 2014).

Every time this balance is changed, changes occur, such as, for example, the contraction of dental arches in animals submitted to glossectomies, when compared to animals control. That way, when a tooth is extracted, its antagonist continues the process of passive eruption, indicating that the eruption remains basically unchanged when life and that the teeth seek contact occlusal or incisal until they reach equilibrium (VERRI et al., 2017)

Based on this idea of balance, countless etiological factors linked to oral function were associated with MAA, such as, for example, habits suction, presence of hypertrophic lymphoid tissues, mouth breathing, atypical phonation and swallowing, and anterior tongue posture at rest. It should be noted, however, that not all of these etiological factors have a causal relationship and absolutely clarified effect (VIEIRA et al., 2018)

For a correct diagnosis, it must first be understood that every malocclusion has a dental and a skeletal component;

It is the predominance of one of these components that determines its main characteristic: dental or skeletal (JANSON; VALARELLI, 2015).

According to MOYERS, in 1991, the open bite can be (1) simple, when it shows interference in the eruption of the anterior teeth and in the alveolar growth; and (2) skeletal, when vertical skeletal dysplasias occur. When the cephalometric analysis reveals normal values in the vertical direction and the problem is concentrated in the teeth and alveolar process, the open bite is simple (VIEIRA et al., 2018).

It is considered as an open bite skeletal is that which presents characteristics such as rotation of the palatal process in a counterclockwise direction, associated with an increase in height anteroinferior facial (AFAI), rotation jaw down and back, obtuse gonioc angle and shortened mandibular ramus (ANTOUN et al., 2018).

Due to the numerous etiological factors described in the literature, different types of treatment have been proposed for the correction of MAA, there is still a consensus on what would be the best treatment for this malocclusion. Basically, different types of treatment can include: (a) behavior modification to elimination of abnormal habits or functions; (B) orthodontic movement through extrusion anterior teeth or molar intrusion; and (c) surgical treatment of bone bases. The only consensus that seems to exist is that the treatment of MAA is difficult and of little stability (FONSECA et al., 2019).

Myofunctional therapy is used for modifying function and consists of a set of exercises to re-educate the orofacial muscles in swallowing, phonation and postural resting position. It is believed that voluntary activities such as swallowing and phonation are more easy correction using myofunctional exercises, while involuntary activities such as postural language habits are difficult to automate (VIEIRA et al., 2018).

Another way to correct functional habits is to through mechanisms that prevent the language rest on your teeth. The most known are palatal or lingual grids and active tips or spurs. There is a consensus that these devices must be fixed, with the intention of re-educating the function until the automation of the movement is obtained QUINTÃO et al., 2017).

Palatal or lingual grids aim to correct the MAA by preventing the language from leaning on the teeth. They need to be long to prevent the tongue is positioned below them. However, as they are smooth structures, they allow the tongue lean on them in such a way that, in some

cases, this prevents their functional re-education. In these cases, the tongue returns to its original position, as demonstrated by the cinefluoroscopic method, thus causing MAA to recur (DOMANN et al., 2016).

The palatal grid is described as the best device for the correction of the alveolar anterior open bite. This device is used in the arc superior and can be fixed or removable, depending on the degree of collaboration of the patient. It is a passive device, with an effect restricted to the incisors, acting only as a mechanical obstacle, which not only prevents the digital suction or pacifier, but keeps the tongue in a more withdrawn position. Vertically, the palatal grid should extend up to the lingual region of the lower incisors, providing a seal of the area of the open bite. Containment can be performed with the device itself, for 3 to 6 months. Preferably, the fixed palatal grid is used, because, in addition to not depending on the patient collaboration, provides faster and safer results (ANJOS et al., 2018).

III. METHODOLOGY

Integrative review, with a qualitative approach, whose data collection was carried out in January 2021, developed in six stages. In the first two stages, the justification, the question and the objective of the research were outlined. In the third stage, the Scielo, Pubmed and Lilacs databases were defined as research sources.

In the fourth stage, the inclusion criteria were: articles focused on orthodontic treatment of the anterior open bite (MAA), recorded from January 2015 to December 2020, containing the words "Orthodontics", "Open Bite", and "Previous Open Bite ", or in the title, abstract or keywords. In the fifth stage, a critical evaluation was carried out through a data collection script with the following information: author, year, objective, methodology and main results. In the sixth and last stage, the results were obtained, using content analysis for theoretical evaluation.

IV. RESULTS AND DISCUSSION

In the first stage of the study, 227 articles were found, which referred to the orthodontic treatment of the anterior open bite (MAA). After reading the titles of the selected articles, 112 articles were selected. After reading the abstracts, only 55 studies were selected to be included in the critical and integral reading. Finally, 13 studies met the inclusion criteria, as shown in Figure 1.

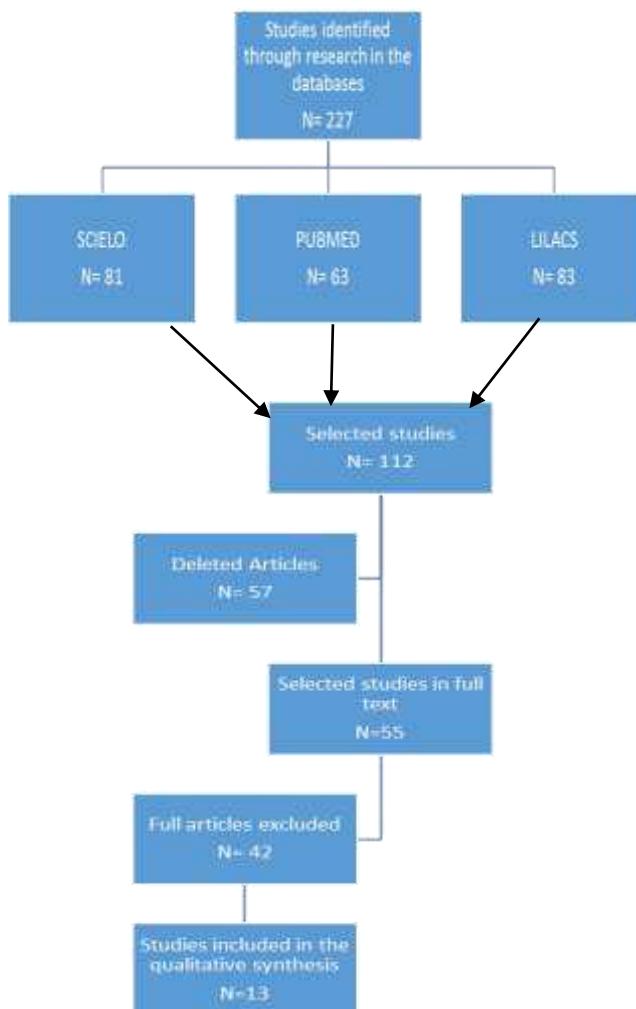


Fig. 1: Selection of studies for review.

This review consists of 13 articles published from January 2015 to December 2020. Of the selected sample,

four were literature reviews, eight were clinical cases and one cross-sectional study, as shown in Table 1.

Table 1: References used in this review.

Authors	Year	Methodology	Objective	Main results
Fonseca et al.	2019	Literature review	Check if the deleterious habits of pacifier sucking, bottle feeding and finger sucking have any influence on the changes found in the stomatognathic system of the patient with a bite previous open.	Such results expressed that there is no significant differences between nozzle suction, orthodontic and conventional nozzles present the same rate of influence on the implications for the stomatognathic system. And that there is no possibility of conclude the existence of differences regarding the consequences to the stomatognathic system caused by by conventional or orthodontic nipples of both pacifiers and bottles.

Passos et al.	2019	Clinical case	To describe a clinical case of an adult patient with skeletal MAA treated with an orthosurgical approach with multisegmentation of the maxilla.	Considering the patient's age, skeletal changes and history recurrence, orthosurgical treatment was chosen, with advancement, intrusion and expansion of the maxilla, as well as correction of the inclination of the palatal plane. The treatment time was 24 months. At the end of treatment, the patient improved occlusion and aesthetics facial and smile. One year after the end of the treatment, the results were stable.
Tavares e Allgayer	2019	Clinical case	Discuss the treatment modalities of MAA, its advantages and implications.	The standard approach to treat adult patients with dentofacial deformities is the surgical-orthodontic treatment. By careful diagnosis and treatment, the problems diagnosed could be treated effectively and efficiently. The success and stability of treatment of severe AOB depend on an integrated multidisciplinary approach.
Anjos et al.	2018	Clinical case	To report the importance of orthodontic / orthopedic devices, in the period of facial cranial growth and the action of these devices in the treatment of anterior open bite, whose etiology was related to the habit of digital sucking.	With the intervention of these devices, we observed that the techniques used orthodontic / orthopedic, are being efficient in expanding the upper dental arches and inferior, both in the transversal and sagittal directions. He can-one can also observe the rebalancing of the lingual posture, thus obtaining the closure of the anterior open bite, rebalancing the patient's entire stomatognathic system.
Antoun et al.	2018	Literature review	Review articles about the previous open bite	Health professionals need to identify early the presence of habits deleterious oral health, as prevention results in a better quality of life for the patient, favoring adequate conditions for feeding, breathing and speech, improving harmony and facial balance.
Vieira et al.	2018	Literature review	Make an analysis of the treatment of anterior open bite (MAA), through a literature review.	Therefore, we seek to bring a better understanding of the subject, bringing a theoretical framework for health professionals on the exposed situation, highlighting the treatments most used in patients with occlusion problems that can have quite satisfactory results.
Arroyo et al.	2017	Clinical case	Present through a clinical case that sought the FAIPE	Vertical discrepancies are one of the biggest

			orthodontic specialization clinic, with maxillary atresia, anterior open bite and thumb sucking habit.	challenges to the clinic orthodontic, because those patients who have a vertical growth pattern must be treated with the utmost care. Environmental factors such as habits non-nutritive suction and mouth breathing, are one of the main causes of poor occlusion. Intercepting open bite cases can often seem simple, but it requires extreme care.
Quintão et al.	2017	Clinical case	Describe the treatment of an anterior and lateral open bite associated with the congenital absence of permanent teeth.	The planning of the case involved a non-surgical treatment, with vertical growth control, obtaining correct overbite and closing of the upper spaces. The case ended with a good intercuspal position, contemplating facial and dental aesthetics.
Verri et al.	2017	Clinical case	Describe the treatment established for a 13-year-old patient, presenting an anterior open dentoalveolar bite, caused by the habit of digital sucking until the age of 9, which triggered a lingual interposition and difficulty in proper phonation.	The proposed treatment was simple and effective orthodontics through the extrusion of anterior teeth using intermaxillary elastics, supported by a pre-adjusted metallic fixed orthodontic appliance (Andrews Prescription, slot 0.022") and clinical control showing stability after 2 years. The orthodontic treatment performed was satisfactory, but it is necessary to highlight the importance of the participation of speech therapists so that there was stability of the occlusion and return of muscle functions to normal.
Bonna et al.	2016	Clinical case	To report the clinical case of a patient with anterior open bite (MAA) associated with the harmful oral habit (HBD) of digital sucking and the importance of interaction between professionals in comprehensive treatment	The MAA intervention requires a multidisciplinary approach in order to reestablish the occlusion, providing an improvement in the child's self-esteem and, consequently, in the quality of life.
Domann et al.	2016	Clinical case	To establish a guide for the differential diagnosis between anterior open dental bite and anterior open skeletal bite.	There was an improvement in the clinical picture with closure of the bite previous open. Early treatment of this condition should always be indicated, with in order to prevent the development of a more complex malocclusion in the future, that would make the treatment more extensive and costly. Decreasing the possibility of recurrence and increasing the stability index.
Miotto et al.	2016	Cross-sectional study	To verify the prevalence of anterior open bite and possible associations with sociodemographic variables, non-nutritive	A prevalence of 16% was found anterior open bite, associated with the male gender ($p = 0.008$), digital suction ($p = 0.011$), with the use of

			sucking habits and bottle feeding in children aged 3 to 5 years.	baby bottles ($p = 0.026$) and pacifiers ($p < 0.001$). The prevalence of open bite in preschool children was considered important and significantly associated with sucking habits.
Nakao et al.	2016	Literature review	Conduct a narrative review of the harmful oral habits that cause MAA	Orthodontists need to know harmful oral habits, because the concept of prevention results in the best quality of through the establishment of adequate conditions for feeding, breathing and speech, favoring harmony and balance between skeleton, soft tissue, morphology and dental volume, which have direct interference on the occlusion. This malocclusion when diagnosed and intercepted early, increases the likelihood of success of the orthodontic therapy.

The anterior open bite is one of the malocclusions greater functional aesthetic impairment. This is defined by the presence of a negative vertical overlap between the incisal edges of the upper and lower anterior teeth (FONSECA et al., 2019; BONNA et al., 2016).

This causes dental and skeletal changes, making it difficult to seize and cutting of food, in addition to harming the enunciation of certain phonemes, which can create conditions unfavorable psychological conditions (PASSOS et al., 2019; ARROYO et al., 2017).

The anterior open bite requires professionals to immediate intervention, after the age of five, before eruption of permanent teeth, because the sooner the treatment is carried out, the faster and more stable the results. Early treatment, although relatively simple there is a need for a multidisciplinary approach, involving quite different areas, such as psychology, speech therapy, otolaryngology and orthodontics (TAVARES; ALLGAYER, 2019; ANJOS et al., 2018).

Orthodontic treatment planning differs according to the etiology and diagnosis of the bite open. Thus, the differential diagnosis between anterior open dental and skeletal bite is of fundamental importance. Radiographic cephalometry is an excellent instrument for diagnosis of these anomalies, which greatly helps in determine the most appropriate procedures for treatment. Steiner (1953) stated that the cephalometric tracings, even though they are not mathematically and geometrically accurate, provide a good interpretation of the results obtained, a more scientific guidance for diagnosis and planning orthodontic treatment

(VIEIRA et al., 2018; QUINTÃO et al., 2017; NAKAO et al., 2016).

The palatal grid is described by several authors as the best device for the correction of the anterior alveolar open bite. This device is used in the arc superior and can be fixed or removable, depending on the degree of collaboration of the patient. It is a passive device, with an effect restricted to the incisors, acting only as a mechanical obstacle, which not only prevents digital or pacifier sucking, but it also keeps the tongue in a more withdrawn position, preventing its interposition in the anterior teeth (MIOTTO et al., 2016; ANTOUN et al., 2018).

Palatal or lingual gratings are indicated to correct the MAA, because they require the tongue to rest on the teeth, they need to be long to prevent the tongue from positioning itself below them. However, they are smooth structures and allow the tongue to stay supported on the grid. The spurs force a change in the resting posture of the tongue, which modifies the sensory perception of the brain, thus obtaining a new motor response. That answer can be permanently printed in the brain, which explains the possible permanent change in the lingual posture produced by the spurs (ANJOS et al., 2018; DOMANN et al., 2016).

V. CONCLUSION

In clinical situations where a diagnosis is anterior open bite, during the mixed dentition period, the treatment option is the indication of the removable acrylic with Hawley's arch, the expander screw and palatal grid. However, it is important to note that success treatment in this case is also due to the cooperation of the patient.

Clinical studies on MAA are, in general, experimental case-control models with small samples and the absence of a control group. This makes the information we have about this malocclusion are incomplete and therefore inconclusive. Further studies should be carried out with more significant samples.

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